

RE-SURVEY OF THE ALIEN VEGETATION IN THE CAPE PENINSULA

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ABSTRACT

A distribution study of woody alien species in 87 sample sites in the northern half of the Cape Peninsula was carried out in 1959/60 by Hall (1961). In 1976 the same sites were re-sampled to assess the change in distribution and infestation over the subsequent 16 years. The effects of clearing and fire were examined and it was concluded that there had been a small but definite increase in the infestations of some species. In spite of extensive clearing, *Pinus pinaster* remains the most widespread invasive alien species.

UITTREKSEL

HEROPNAME VAN DIE UITHEEMSE PLANTEGROEI IN DIE KAAPSE SKIEREILAND

'n Verspreidingsstudie van die houtagtige inheemse soorte in 87 monster persele in die noordelike helfte van die Kaapse Skiereiland is in 1959/60 deur Hall (1961) gedoen. Gedurende 1976 is heropnames in dieselfde persele gedoen om die verandering in vervuiling gedurende die voorafgaande 16 jaar te bepaal. Die invloed van opruiming en vuur is bestudeer en daar is tot die gevolgtrekking gekom dat daar in klein maar bepaalde toename in die vervuiling van sekere soorte was. Ten spyte van grootskaalse opruiming bly *Pinus pinaster* die mees wydverspreide uitheemse-, indringersoort.

INTRODUCTION

Between May 1959 and May 1960, Hall (1961) conducted an extensive survey of the distribution of woody alien species in the mountains of the northern part of the Cape Peninsula. He examined the distribution of species above the 500 ft (152 m) contour. In 1976 Hall's plots were re-assessed (by McLachlan) to establish what changes had occurred.

SAMPLING METHODS

Hall (1961) selected an area of about 102 square kilometres for his survey. Intersections of the thousand yard grid lines of the 1951 Trigonometrical Survey Map were chosen as the sample sites. Only those points above the 500 foot (152 metre) contour, and not in plantations, were examined. The points were located in the field using an altimeter and prismatic compass. At each site altitude, soil type, moisture, aspect, post-burn age, numerically and physiognomically dominant indigenous species, and the average cover, height and density of the community was recorded. Alien plants were recorded in terms of their density within a radius of 200 yards (183 m) of the sample point. The survey was restricted to species

whose arborescent life-form was likely to cause changes in the structure and species composition of the Cape flora.

The same sample points were re-located in 1976 using the Trigonometrical Survey Map and Hall's original site photographs. It was found that most of the sites could be located accurately using the photograph, and in most cases the beacon built by Hall, marking the exact location of the site, was also found. Data were collected in the same way as in 1959/60, though some additional information was also recorded; such as observations on clearing and the effects of fire.

DISTRIBUTION PATTERNS

In 1959/60, the percentage occurrence of each alien species in the 87 samples was calculated and compared to the occurrence in 1976.

TABLE I.
Percentage occurrence of alien species in the 87 sample sites.

	1959/60	1976
<i>Pinus pinaster</i>	82	75
<i>Hakea gibbosa</i>	21	27
<i>Pinus pinea</i>	6	4
<i>Hakea sericea</i>	9	12.5
<i>Pinus radiata</i>	11	5
<i>Hakea suaveolens</i>	11	9
<i>Acacia cyclops</i>	17	17
<i>Acacia saligna</i>	16	25
<i>Eucalyptus</i> sp.	4	5
<i>Albizia lophantha</i>	7	6
<i>Acacia longifolia</i>	7	8
<i>Acacia melanoxylon</i>	6	4
<i>Pinus canariensis</i>	0	5

It is apparent that *Pinus pinaster* is the most widely dispersed alien species in the study area, though it has not extended its range over the 16-year period. Two *Hakea* species (*H. gibbosa* and *H. sericea*) occur in a greater number of sites than was found in 1959/60. The *Acacia* species, especially *A. saligna*, have also apparently spread over the years, as has *Eucalyptus* and *Pinus canariensis*. For the other species the percentage occurrence has changed very little. *A. cyclops* has apparently not increased much over the last sixteen years. The data for *A. longifolia* show that this species has not spread, though it has apparently spread in areas outside the sample sites (Moll & Campbell, 1976).

The distribution patterns of the introduced species in 1959/60 and 1976 are summarized and compared in Figs 6-14. The aliens are grouped into density classes as follows: 1-19, 20-50, 51-200, 200 + trees within a 200 yard (183 m) radius of the sample point.

Pinus pinaster is the most widely dispersed of all the introduced species and occurred in 82% of the sites examined in 1959/60 and 75% of the sites in 1976. It is more-or-less evenly distributed over the 102 square km of the study area, with occasional dense stands in some areas (see Fig. 6). The pattern of distribution of *P. pinaster* has altered over the 16 years; in 15% of the sites the density has drastically increased, and in 32% of the sites the density has decreased. This decrease in density is due mainly to clearing. *P. canariensis* (Fig. 14) has appeared in a number of sites, but only isolated trees were found. *P. radiata* (Fig. 9) and *P. pinea* (Fig. 14), on the other hand, are found only in isolated areas and have not spread.

Hakea populations have definitely increased slightly over the 16 years, and isolated plants and dense clumps of the different species were found at previous *Hakea*-free sites (notably *H. gibbosa* and *H. sericea*). *Hakea* spp. occur mainly on the lower, drier, western slopes of Table Mountain and on the north-western slopes of Vlakkenberg, Skoorsteenkop and the Muizenberg Mountains (see Figs 7, 8 and 9).

Acacia cyclops is still extensively distributed on the lower western slopes of Skoorsteenkop, Noordhoek Peak and Spitzkop. This species has spread to a number of other sites especially where the soil has been disturbed. *A. saligna* has also spread rapidly to a number of previously uninfested sites at slightly higher altitudes on the Muizenberg Mountains and on Skoorsteenkop and Vlakkenberg (see Figs 10 and 11).

Albizia lophantha (Fig. 12) is found mainly at the sites surrounding the Houtbaairivier valley and Orange Kloof. Apart from being found in broad-leaved scrub (McKenzie, Moll & Campbell, 1977) it also occurs on forest margins and in open forest (Moll & Campbell, 1976). Its spread has been checked by clearing in some sites. *Eucalyptus* sp. (Fig. 12) was found in a number of new sites where it has been planted as a windbreak or as isolated escapes.

RATE OF INFESTATION

Only a few sites in the study area have been relatively undisturbed by man over the last 16 years. Five high altitude, relatively undisturbed sites of similar environments, with different size populations of *P. pinaster*, were chosen to gain an assessment of rate of infestation. These sites which had not been burned since 1959/60 were also far from *P. pinaster* plantations (which would provide an additional seed source). The density of trees at the five sites in 1959/60 and 1976 were compared, and the data are represented graphically (Fig. 1). The curve indicates the rate of infestation of *Pinus pinaster* from a single tree to the maximum density attainable (the steeper the slope of the curve, the faster the rate of spread). Initially the increase is relatively slow, until the population is some one

tree per 6 000 sq. m., then the increase in density is extremely rapid until the number of trees is about one tree per 40 sq. m. Once the pines have formed dense stands the rate of infestation slows until maximum density is attained. The 45° line on the graph indicates where "no change" occurs, and those sites below the line demonstrate the effects of clearing pines thus reducing spread. It is estimated that the time needed for one tree of *Pinus pinaster* to form a dense population will take from 35 to 45 years. At many sites young *P. pinaster* were found scattered in fynbos areas adjacent to dense stands and plantations. Thus the continued presence of these *P. pinaster* plantations and infestations on the mountains ensures a continued source of seed. The widespread distribution of *P. pinaster* is undoubtedly a result of its dispersal efficiency, and its ability to adapt to various habitats within the mountain fynbos biome.

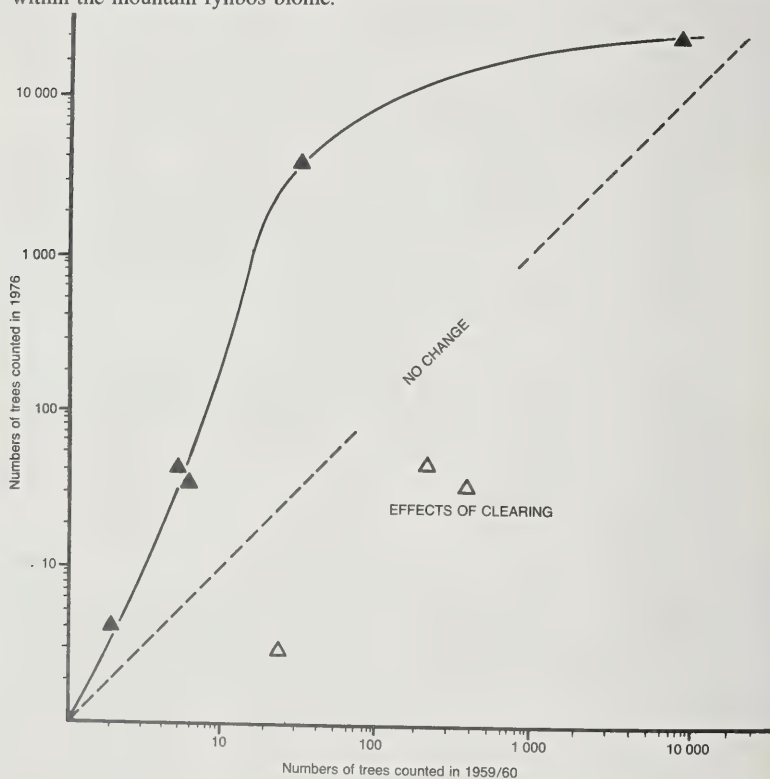


FIG. 1.

A graph comparing the numbers of trees counted in 1959/60 (▲) and 1976 (△) at five undisturbed sites. Three sites demonstrate the effects of clearing.



FIG. 2a. 1959/60



FIG. 2b. 1976

P. radiata is not considered to be an important pest, and although isolated trees were found in a number of sample sites in 1959/60 none were found in 1976 (see Fig. 9). The species does not spread rapidly and the isolated trees were probably cut down.

Hakea species on the other hand have a great potential for increase in population size because of the vast quantities of seeds produced. At many sites young, even-aged stands, that had been seeded from two or three adult plants which had died, occurred and dense stands were formed in some 1 to 5 years. Thereafter the density of the stand seems to remain static for a number of years if the area is left undisturbed. *Hakea sericea* and *H. gibbosa* characteristically form very dense stands (up to 150–250 plants per 100 m²). Although the *Hakea* spp. occur mainly on the drier sandy and granitic soils, and were documented by Hall (1961) as being rare on moist slopes, their encroachment into new sites is occurring, and currently all species are also found in both relatively moist fynbos and in forest scrub. Many of the alien species, including *Hakea*, are rare at high altitudes. This is probably due to relatively slow dispersal rates and because the distance from seed sources is great, and is not due to habitat conditions precluding their growth.

It was noted that the *Acacia* species also occurred at a number of new sites at higher altitudes, especially *A. saligna* (Fig. 11), suggesting that these species also have the potential of spreading to a variety of mountain habitats. *A. longifolia* and *A. cyclops* showed their capacity to grow more densely in previously infested areas after clearing (see Figs 10 and 13). *A. longifolia* is also present in disturbed indigenous forest. Both species are common in areas where the soil has been disturbed. *A. melanoxylon* and *Albizia lophantha* are able to invade scrub and thrive in disturbed forest communities, though *A. melanoxylon* is probably only a real threat to riverine communities in the study area (see Figs 12 and 13).

At 15 sites there was a high percentage of seedlings of *Pinus pinaster*, *Acacia saligna* and all three *Hakea* species in areas nearly free of adult plants.

Another feature of most alien species found in the study area is the development of clumps or scattered stands of the same age. In *Hakea* this is particularly evident as mass seed dispersal and simultaneous germination is usually induced by fire or injury. In eight sites *Pinus pinaster* was noted to occur as clumps of similar aged individuals. This tends to indicate that dispersal of *P. pinaster* seed is not random, but that seeding rates or seedling regeneration is dependent upon specific environmental and/or physiological factors.

At each site where there was evidence of clearing of *Pinus pinaster* the approximate numbers of felled trees was noted. There was evidence of clearing at 46 of the sites visited. At 17 of these sites there was evidence of only a few isolated trees having being cut down, and at the remaining 28 sites there was evidence of extensive clearing. Of these 28 sites 14 showed that felling of *P. pinaster* had been effective in drastically reducing the population and the spread of



FIG. 3a. 1959/60

FIG. 3b. 1976



Comparative photographs showing areas cleared of *Pinus pinaster* at Bokkop.

this species. In areas where very dense stands had been felled and where 45 % of the cover is cut alien material, the regeneration of the indigenous flora is slow. In other areas where heavy cutting had taken place after 1959/60, but probably before about 1968, the regeneration of indigenous flora was apparently unaffected where the previous population of pines was less than one tree per 300 m². Two sites had been burnt after cutting and thus nearly all evidence of previous pine infestation in the area was destroyed. Here the fynbos appeared to be almost completely restored, with similar floristic composition at the previous infested areas as compared to previous near-free areas. This re-survey, therefore, seems to demonstrate that felling of *P. pinaster* is an effective measure of control.

FIRE

Fire is of some significance in both the increase and decline of alien populations. It is generally known and well documented that the spread of *Hakea* spp., and to a lesser degree, *Acacia cyclops*, is aided by fire (see Stirton, 1978). With regard to *Pinus pinaster*, Adamson (1927) mentions that its invasive ability is greatly assisted by reduced competition from the fynbos brought about by frequent fires. In the sites examined this was not always the case. Some 32 % of the sites had been burnt in the last five years, of these there was evidence in nine sites of fire destroying *P. pinaster* trees. In four sites between 15 and 150 trees, 2–4 m high, were killed in the fires and this indicated that fire can be an important controlling factor in the spread of *P. pinaster* seedlings and young plants, as is also the case with *Hakea* seedlings. At one site half of the area had been recently burnt in a fire. The other half had not been burnt for at least 20–30 years and was infested with *P. pinaster* at about one tree per 250 m². In the burnt area, which had a high cover of *Mimetes*, not one pine seedling or tree was found.

CONCLUSIONS

In general, there has been a small but definite increase in the areas infested by *Hakea gibbosa*, *Hakea sericea*, *Acacia saligna*, *Pinus canariensis* and *Eucalyptus* sp. *P. pinaster* was found at somewhat fewer sites than before, and in most of the samples the density of *P. pinaster* had decreased. The felling of many dense stands of *P. pinaster* (see Figs. 2, 3 and 4) has without doubt drastically reduced the rate of spread in the study area, and probably more important is that large areas once lightly infested by *P. pinaster* have been cleared, thus preventing these areas from becoming densely infested.

A comparison of the density of *P. pinaster* and *H. gibbosa* over the 16-year period shows that in 1976 there were a few more sites having a low density of *P. pinaster* than in 1959/60, and that there is a general reduction in the densely infested areas. *H. gibbosa* data show that there are many more lightly infested sites, so the potential for spread is much higher (Fig. 5) *H. gibbosa* and



FIG. 4a. 1959/60



FIG. 4b. 1976

High rates of infestation by *Pinus pinaster* have occurred at some sites. In this case the beacon has been obscured by growth.

H. sericea have not, therefore, spread as much but are much more of a potential hazard as eradication of these species is much more difficult. It is of great concern that this survey indicates that there are large areas in the Cape Peninsula lightly infested—which have the potential of forming dense stands.

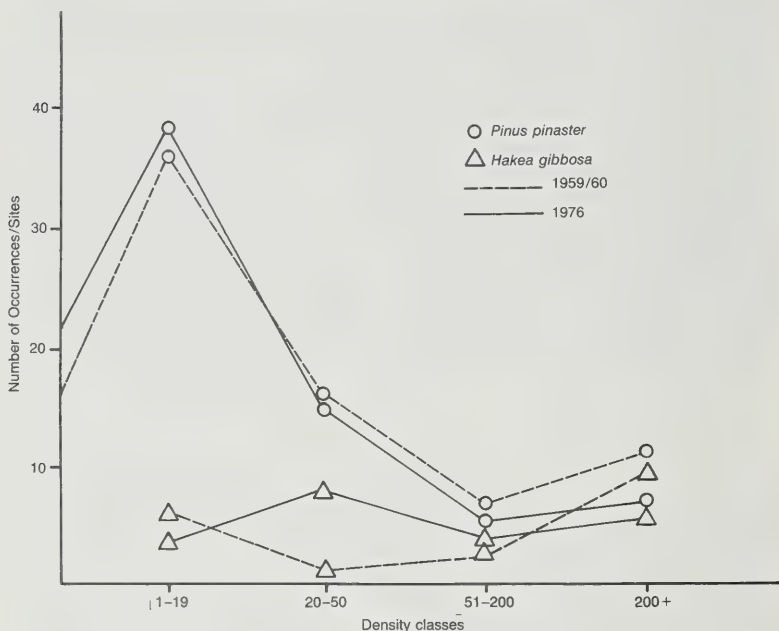


FIG. 5.

A graph comparing the number of sites at various class densities in 1959/60 and 1976. Class density is expressed as the number of plants within 183 m of the sample points.

Of all the alien species *P. pinaster* is by far the most efficient spreader in terms of area, but it can also be cleared relatively easily and effectively. Although large areas have been cleared, isolated trees and dense stands still remain in most areas and until these are cleared there will always be encroachment.

Alien species, which are more difficult to eradicate, even though some may spread more slowly, will also eventually encroach into most areas of the mountains in the future. Some of these species, such as *Hakea* spp., *Albiza lophantha* and *Acacia* spp., are able to form dense stands in many habitats. It is these species that will present a major problem, probably even more so than the present problem of the widely-distributed *P. pinaster*, in the future.

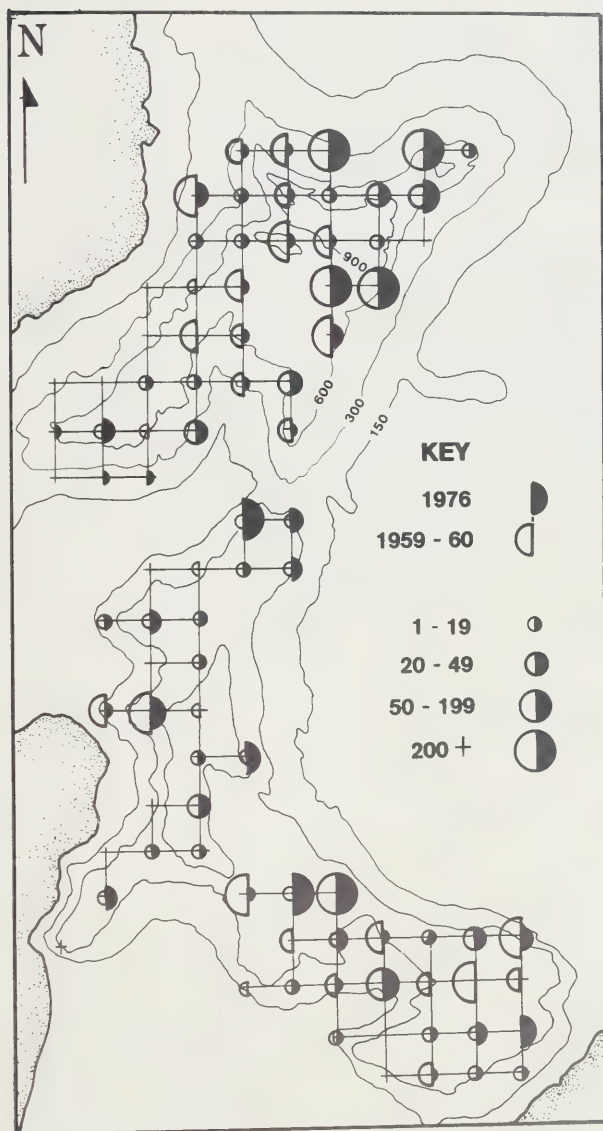


FIG. 6.
Pinus pinaster

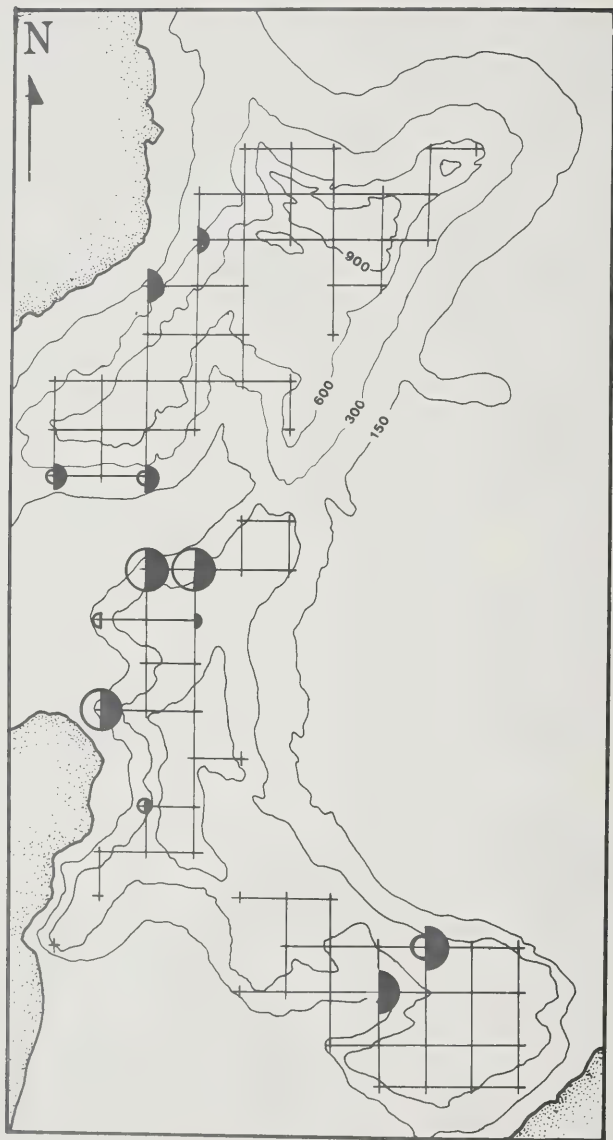


FIG. 7.
Hakea sericea

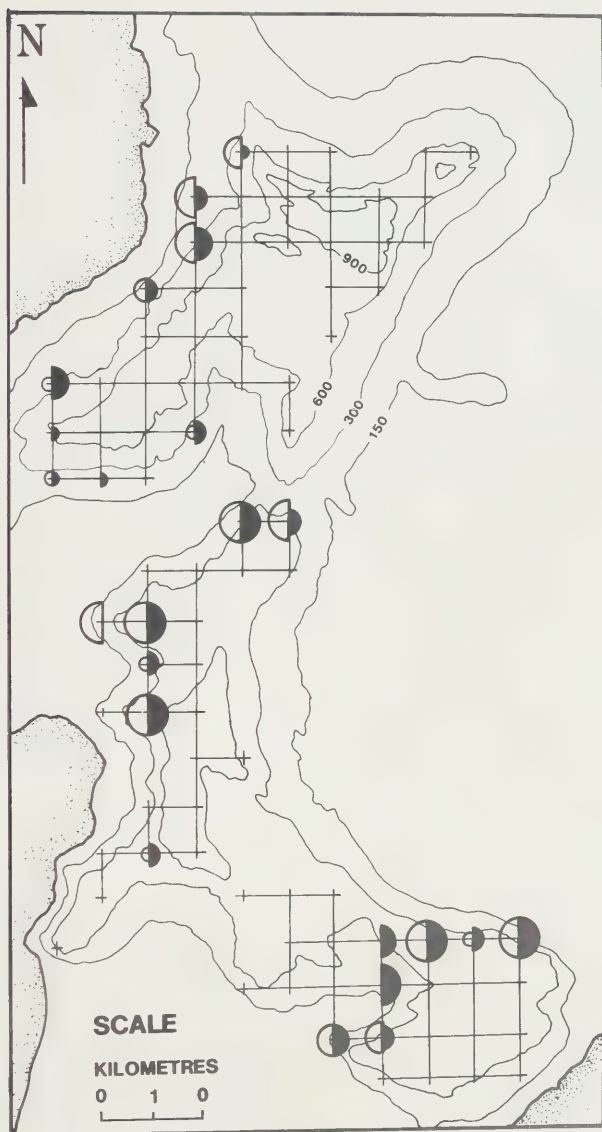


FIG. 8.
Hakea gibbosa

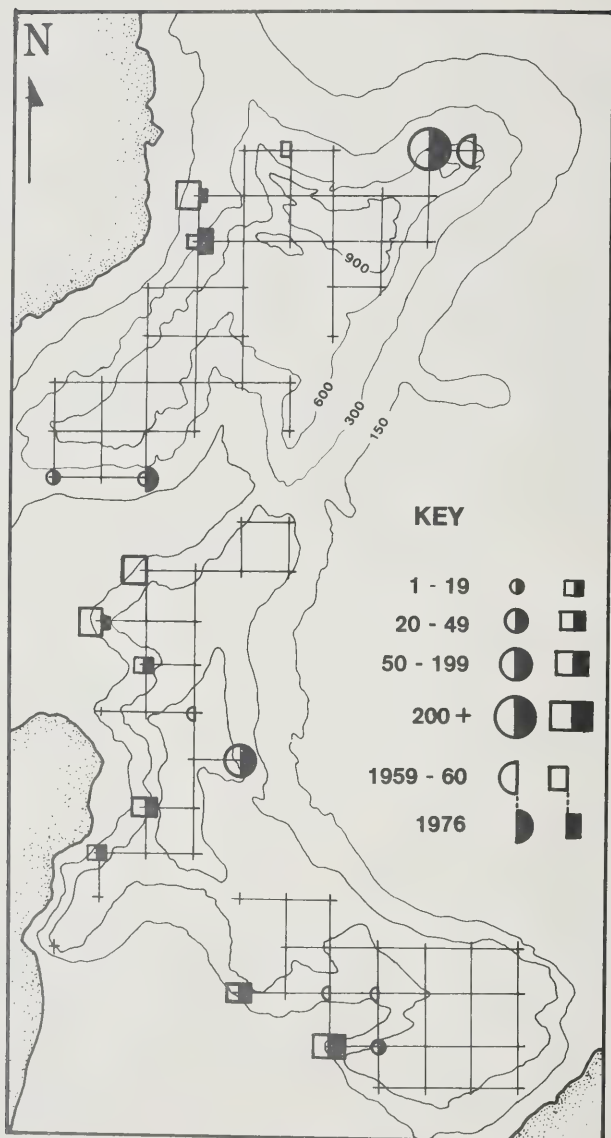


FIG. 9.
Pinus radiata ● *Hakea suaveolens* ◻

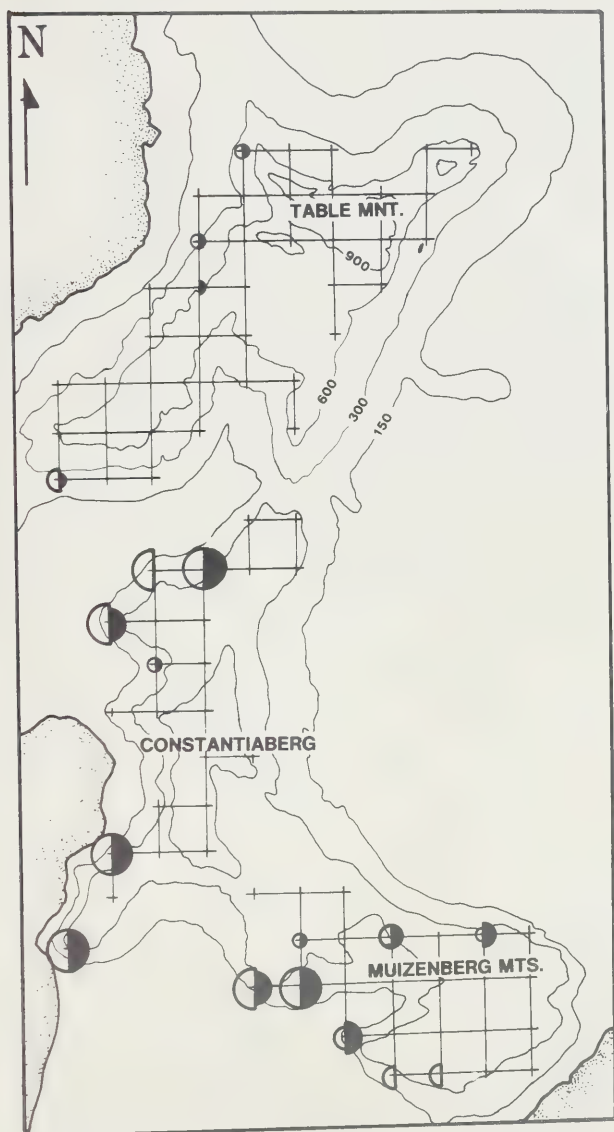


FIG. 10.
Acacia cyclops

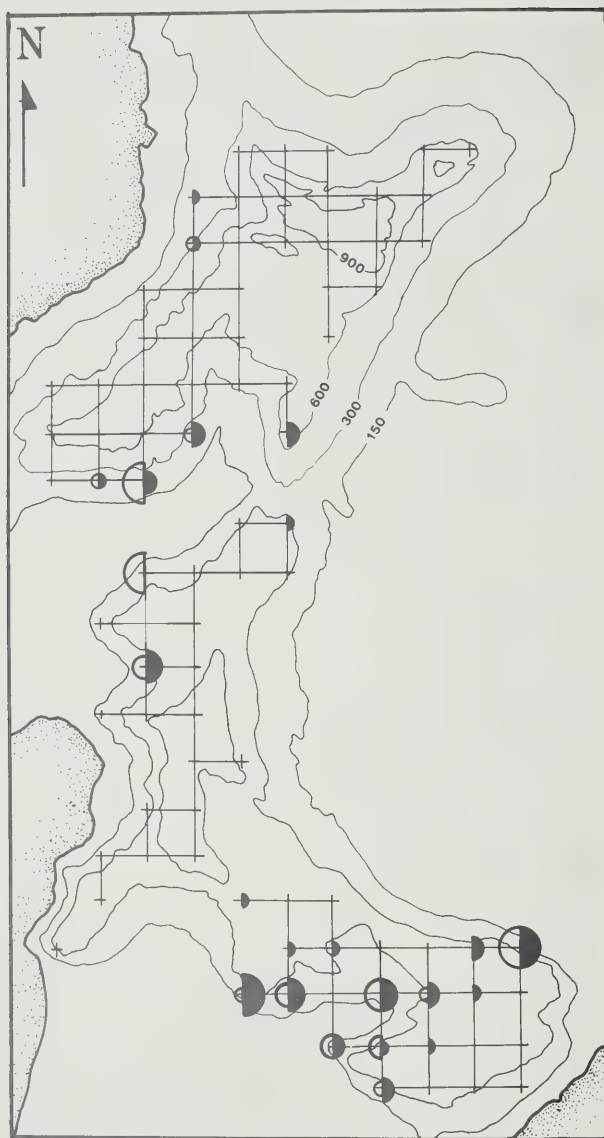


FIG. 11.
Acacia saligna

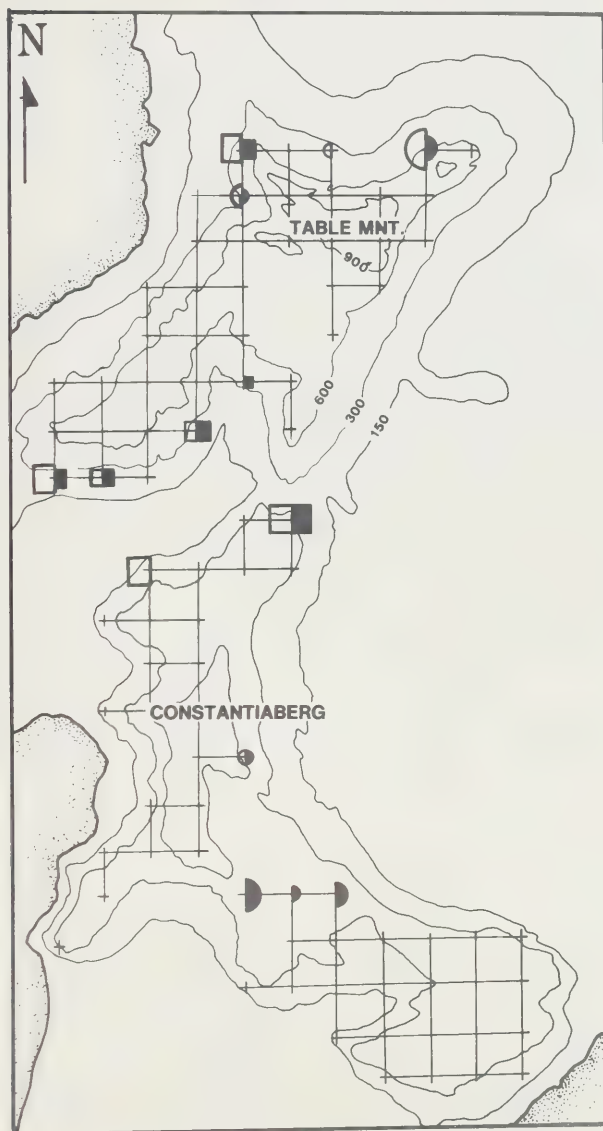


FIG. 12.
Eucalyptus sp. ● *Albizia lophantha* ■

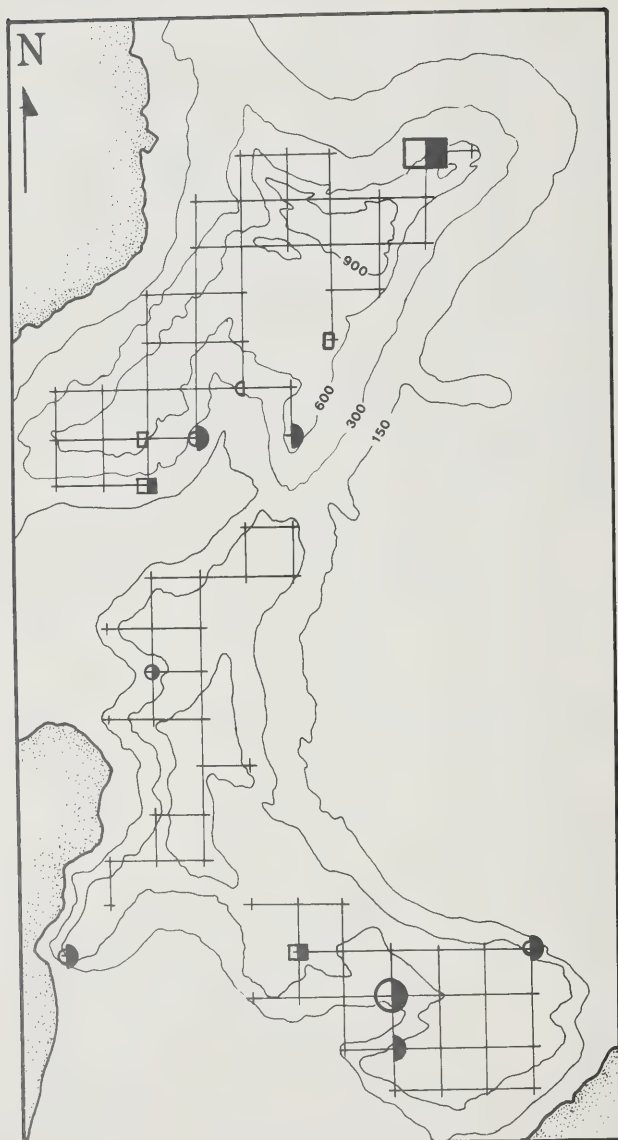


FIG. 13.

Acacia longifolia ● *Acacia melanoxylon* ■

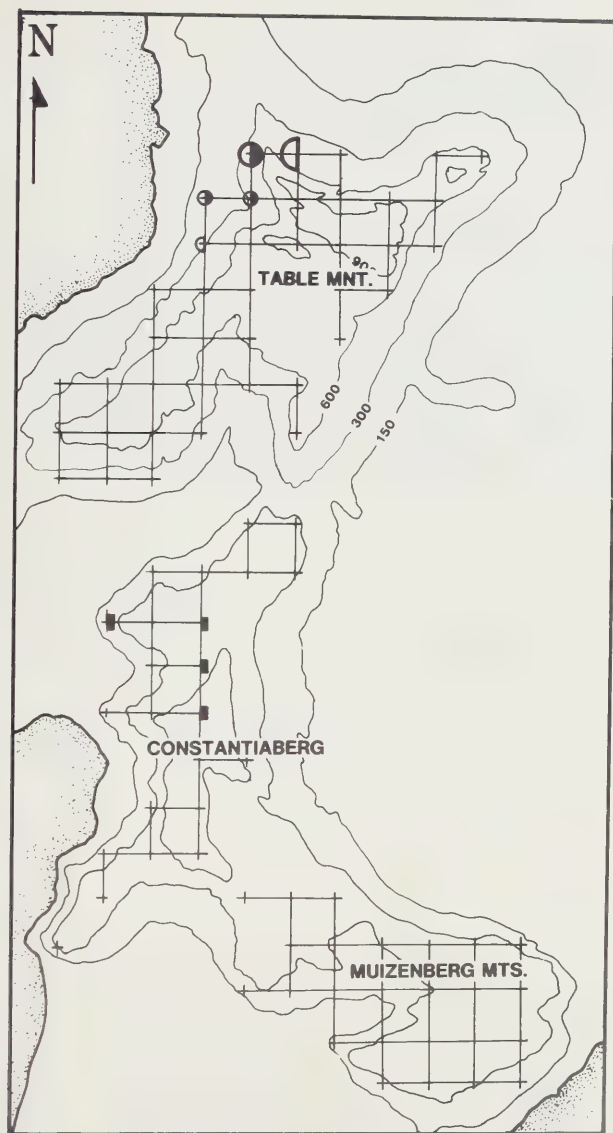


FIG. 14.
Pinus pinea ■ *Pinus canariensis* ●

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